Higgs Factories Session

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Higgs Physics in the Big Picture

- Will the detailed properties of the Higgs boson tell us more about the laws of physics?
  - What is the nature of dark matter?
    - Does dark matter interact with the Higgs boson?
  - Why is there a large-scale universe?
    - Are there symmetries or properties of space-time that made this possible and will such properties be discovered through the detailed study of the Higgs boson?

Major Challenges for Higgs Physics

- The LHC at 14 TeV will probe new physics at and above the TeV scale in a broad sweep
  - Beyond the LHC, the most promising avenue for future exploration is via the Higgs boson properties through high precision measurement.
    - What precision needs to be achieved to guarantee decisive and provocative answers to fundamental questions about the universe and the laws of physics?
- The Higgs boson and the top quark were guaranteed discoveries based on exactly this strategy
  - The basis for the high precision measurements came from the Z factories (over 10^6 Z bosons produced on resonance and studied with polarized beams).

Higgs Factories

- The only two resonance production methods for the Higgs boson ($\mu^+\mu^-$ and $\gamma\gamma$) involve technologies that we have not developed yet
  - But we do believe they will be developed eventually.
- The other directions for high precision Higgs studies involve accelerators that are themselves new energy frontier machines or in some way are designed to expand into new energy frontier machines
  - Since these are non-resonant processes, the Higgs boson measurements get most of their precision from their highest energy operation
  - By choosing these machine technologies we are effectively choosing the future direction of the energy frontier before having decisive constraints to guide us.
  - That might be the only answer, but it would choose between:
    - linear e^+e^- up to 1 TeV or 3 TeV – here there are two accelerator technologies
    - circular e^+e^- up to 240 GeV (350 GeV) followed by pp at 33 TeV (100 TeV) – where the 33 TeV program is HE-LHC in the existing LEP tunnel
    - And it should be noted that $\mu^+\mu^-$ could be extended up to 3 TeV
    - And that $\gamma\gamma$ could be included in a linear e^+e^- energy frontier machine